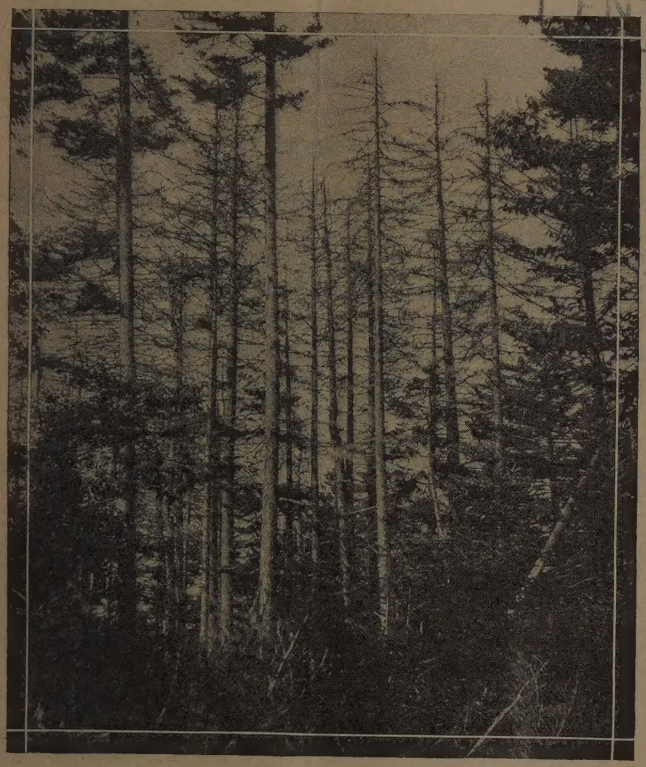
E&A

THE SOUTHERN PINE BEETLE

A Menace to the Pine Timber of the Southern States

A. D. HOPKINS
Forest Entomologist, in Charge of Forest Insect Investigations

10 JUN. 1921
ENTOM.



FARMERS' BULLETIN 1188
UNITED STATES DEPARTMENT OF AGRICULTURE

Contribution from the Bureau of Entomology
L. O. HOWARD, Chief

Washington, D. C. March, 1921

Show this bulletin to a neighbor. Additional copies may be obtained free from the Division of Publications, United States Department of Agriculture

WASHINGTON : GOVERNMENT PRINTING OFFICE : 1921

THE SOUTHERN PINE BEETLE is the most destructive enemy of the pines of all species in the Southern States from Pennsylvania to Texas. It has killed more merchantable-sized timber during the last 30 years than has died from all other causes combined. Between 1890 and 1893 it killed a very large percentage of the yellow, pitch, and white pines of West Virginia and Virginia, and, since the earliest records in 1842, has killed a vast amount of timber in the Atlantic and Gulf States, most of which has been a total loss.

The prevention of serious outbreaks and the control of this menace to the great timber resources of the South are not only possible but entirely practicable. It is only necessary to cut, and utilize for fuel or lumber during the fall and winter months, all trees that die during the late summer and fall, making sure that the bark of the main trunk is burned.

THE SOUTHERN PINE BEETLE:[1]

A MENACE TO THE PINE TIMBER OF THE SOUTHERN STATES.

By A. D. HOPKINS,

Forest Entomologist, in charge of Forest Insect Investigations.

CONTENTS.

	Page.		Page.
The southern pine beetle: What it is and what it does	3	Patches of dying pine a menace to the healthy trees	9
Evidence of the destructive work of the beetle	5	The more important evidences of the presence and work of the beetle	10
Extent of losses	6	How to locate the infested trees	10
The remedy	7	Essential details in methods of control	11
The cost of control	7	Requirements for success	12
Investigations in the Southern States	8		
Character and range of depredations in 1911	9		

THE SOUTHERN PINE BEETLE: WHAT IT IS AND WHAT IT DOES.

THE SOUTHERN PINE BEETLE is a small brownish or black beetle, somewhat smaller than a grain of rice. It flies from March to December in the more southern sections, and from May to November in its northern range. It attacks the middle to upper portions of the trunks of healthy pine trees, causing their death by excavating long, winding burrows, or egg galleries (figs. 1 and 3), which extend through the inner layers of the living bark and mark the surface of the wood (fig. 2). Eggs are deposited along the sides of these galleries, from which young grubs (larvæ) hatch and then feed on the inner bark until they have attained the size of the parent beetles, when they mine into the outer bark and transform to the dormant (pupal) stage, and later to the adult or beetle stage. The beetles then emerge to fly in search of other living trees, in which this process of attack and development is repeated.

The winter is passed in the bark of the living and dying trees in all stages of development. The more advanced individuals begin to emerge and fly in March to May, and the remainder continue to develop and emerge until about the last of July, so that by this

[1] *Dendroctonus frontalis* Zimm.; order Coleoptera, family Ipidae.

time all of the trees that were attacked during the previous fall and early winter are dead and abandoned by the beetles.

From three to five generations occur annually. The first generation begins with the eggs deposited by the first beetles that fly and attack the trees in the spring and by those of the overwintered broods as they make successive attacks during the spring and early summer.

The second generation begins with the eggs deposited by the adults of the first generation, and so on until cold weather stops their activities.

FIG. 1.—Egg galleries and larval mines of the southern pine beetle: *a*, Entrance; *b*, entrance burrow; *c*, egg gallery; *d*, normal larval mine; *e*, abnormal larval mine; *f*, terminal; *g*, ventilating burrows. Slightly reduced.

At all times there is a more or less complex overlapping of generations, so that emergence and attack are continuous during the entire period of activity; consequently, there is a continuous dying of trees within the infested areas.

Under average or normal conditions of the activities of this beetle a few scattering trees are killed by it each year in mature stands of pine timber throughout the Southern States where the pine is common. If, however, from any cause, conditions become favorable for the multiplication of the insect, it is able to kill groups of trees, and if these groups increase in number and size the following year

they constitute the danger signal of an outbreak which may result in widespread devastations. The southern pine beetle is the most destructive enemy of the pine within its range; in fact, it is a constant menace to the living pine of all the Southern States. (See fig. 4.)

EVIDENCE OF THE DESTRUCTIVE WORK OF THE BEETLE.

The presence of this beetle in dangerous or destructive numbers is plainly indicated by patches of dying and dead pine, which show no evidence of injury by fire or other destructive agencies.

The trees infested by the developing broods are indicated by the fading green, greenish brown, and yellowish red of the foliage and positively determined by the removal of some bark from the *middle* of the trunks of a few of the dying trees and the finding of the characteristic work in the inner bark and on the surface of the wood, as shown in figures 2 and 3.

The trees which have been killed and abandoned by the developed broods of the beetles are indicated by the reddish-brown foliage (abandoned "red tops"), the fallen foliage (abandoned "black tops"), and the decaying standing or fallen trees (abandoned "broken tops" and "snags," fallen trees, etc.). The cause of the death of trees of any of these stages is determined by examining the dead bark for evidence of the work of the beetle.

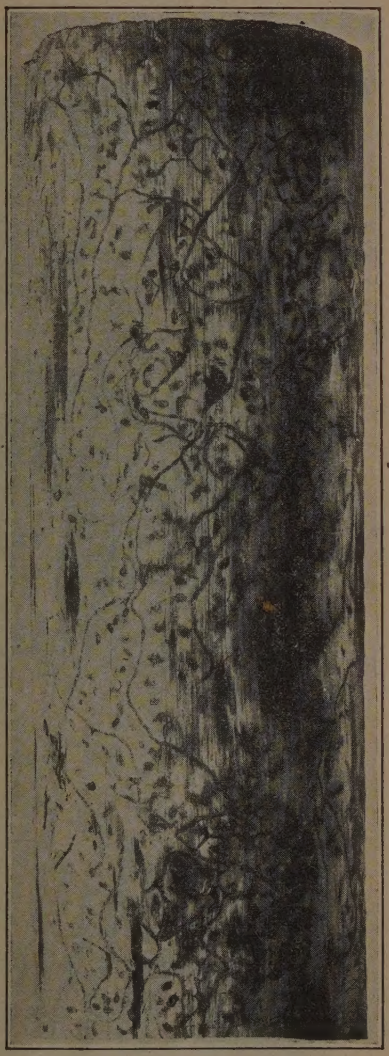


FIG. 2.—Section of pine trunk with bark removed, showing the marks of the egg galleries on the surface.

EXTENT OF LOSSES.

Extended observations in all of the Southern States between 1891 and 1911 led the writer to conclude that if all of the pine that has

FIG. 3.—Bark from pine tree showing galleries of the southern pine beetle, which kills the trees, and the larger mines of the "sawyer," which does not kill trees.

been killed during this time by this beetle were living in 1911 its stumpage value would have amounted to from $10,000,000 to $20,000,000 or more. Studies of the depredations wrought by it in the

South Atlantic and Gulf States in the years 1908 to 1911 indicate that at least $2,000,000 worth of pine was killed during that time. It is evident that if active steps had not been taken in 1911 by the principal owners in the infested areas this loss would have increased to another million dollars within the next year.

Since 1911 no extensive outbreaks have been reported or observed, but there is constant danger that the beetle may again multiply to the danger point.

THE REMEDY.

It has been determined and demonstrated that if the larger part of the infestation within an area of 8 or 10 square miles is disposed of according to the methods discovered and recommended by the

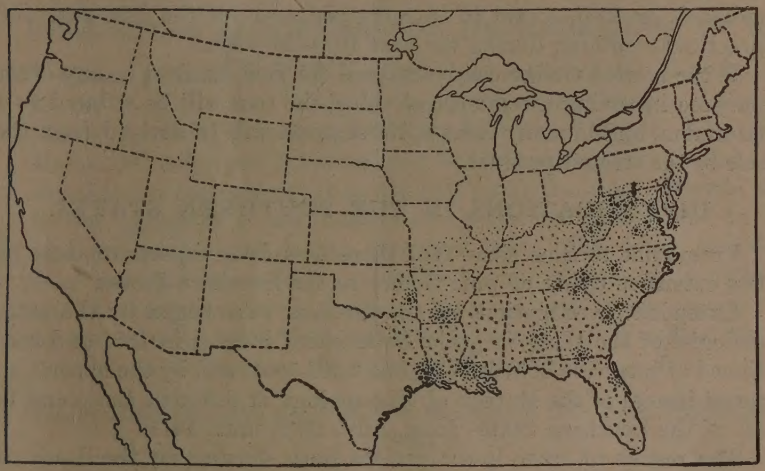


FIG. 4.—Map showing distribution of the southern pine beetle.

experts of the Bureau of Entomology it will bring the beetle under complete control in that area, and that thereafter control can be maintained with but slight trouble or expense. It is therefore evident that if the recommended methods are adopted and properly carried out the beetle can be controlled in any given community, district, county, State, or in the entire South.

Broadly stated, the method of control is to locate the infested trees during November, December, January, February, and March and destroy the overwintering broods in the bark of the main trunks, according to the recommendations on pages 10 to 13 of this bulletin.

THE COST OF CONTROL.

Experience has shown that while a large amount of timber may be dead in a given locality it may be an accumulation of several years or months through the continued dying of the trees, so that only a

comparatively few infested trees are found at any given time. Therefore if this small number of dying and infested trees is disposed of at the proper time and in the proper manner the cause will be removed at small cost and the dying of the pines will stop.

The cost for the required treatment will ordinarily average about 30 cents per merchantable-sized tree.

Protecting the *living* pine of farmers' woodlots and small forests of average-infested areas of 10 to 15 square miles in the central Southern States through a direct control of the beetle will cost from 1 to 10 cents per acre for the first year and practically nothing thereafter for from 10 to 20 years.

The protection of the *living merchantable* pine within a similar average area will cost from 5 to 30 cents per thousand feet, board measure, or from ½ cent to 10 cents per cord for the first year and practically nothing during the next 10 to 20 years.

If the treated timber can be utilized for fuel, lumber, or any other purpose involving a commercial value, the cost will be reduced to a minimum, and in many cases a direct profit will be derived from the sale of the treated product.

INVESTIGATIONS IN THE SOUTHERN STATES.

From time to time since 1842 there have been reports of more or less extensive dying of pine timber in the Southern States.

Extended investigations of the problem were begun by the entomologist of the West Virginia Experiment Station in 1891 and continued at intervals in West Virginia until 1901, and by the experts on forest insects of the Bureau of Entomology at different times and in all of the Southern States from July, 1902, until 1911.

The results of these investigations have shown that the death of a large percentage of the pine of Virginia and West Virginia in the period from 1890 to 1893 was due to an invasion of the southern pine beetle, which attacked the healthy trees and girdled and killed them by excavating long winding burrows beneath the living bark on the main trunks of the trees.

It has also been shown that this beetle has existed in the Southern States for at least 78 years, and there is good evidence that it has occupied this region from time immemorial, but it is only at comparatively long intervals that it increases to such numbers as to cause widespread depredations.

During the summer and fall of 1910 and the winter and spring of 1911 correspondents of the Bureau of Entomology in different sections of the South, and especially in the Atlantic and Gulf States, reported that the pine was dying in patches, and that in some places the trouble was alarming. Therefore it was made the subject of special investigation in May, June, and July, 1911, which resulted

in the location of a forest insect field station at Spartanburg, S. C., for the purpose of studying the character and extent of the depredations and conducting a campaign of instruction and demonstration on the proper methods for controlling the beetle and protecting the remaining living timber. This work was prosecuted in such a manner as to convince the majority of the owners of pine within the areas covered by the representatives of the Bureau of Entomology that the southern pine beetle is a menace to the pine forests of the Southern States. There was a general and widespread interest manifested throughout the worst affected sections, and there is evidence that sufficient action was taken by the owners, in the utilization or treatment of infested trees according to the recommendations, to protect the remaining living pine from further depredations.

CHARACTER AND RANGE OF DEPREDATIONS IN 1911.

The study in 1911 of the character and extent of the depredations by the southern pine beetle in South Carolina, Georgia, Alabama, North Carolina, Mississippi, Texas, Florida, Virginia, Louisiana, Maryland, Arkansas, Missouri, and Tennessee, and information conveyed by correspondents from all sections of the South, showed that in the aggregate a vast amount of timber had been killed by the southern pine beetle during 1910 and 1911. The dying and dead trees occurred as scattering individuals or in clumps, large patches, and in some places whole forests. All were more or less conspicuous by their fading, red, black, or denuded tops, plainly indicating the presence of the beetle or the progress of its work.

PATCHES OF DYING PINE A MENACE TO THE HEALTHY TREES.

It was found that each patch of dying trees, with their fading and greenish-brown tops, located anywhere in the Southern States is a menace to the living pine within a radius of 3 or 4 miles. The broods of the southern pine beetle developing in the bark of the trees of one such center of infestation may swarm in any direction and settle in the healthy timber. Thus one or more additional patches are killed, until nearly all of the large as well as the small pine over an extensive area is dead.

When these centers of infestation are numerous within the confines of a county, or even a larger section of territory, they can only be compared with the starting of so many forest fires; and, as has been demonstrated, they *may lead to far greater destruction of merchantable pine than has ever been recorded as resulting from fire in the Southern States.* Therefore they demand similar prompt and radical action on the part of the owners in order to protect their living pine.

THE MORE IMPORTANT EVIDENCES OF THE PRESENCE AND WORK OF THE BEETLE.

(1) If in clumps or patches of pine, where there is no plain evidence of serious injury by fire, the foliage fades to pale green and changes to yellowish and pale brown, it indicates that the trees are dying from the attack of the southern pine beetle and that the bark on such trees is infested with the developing broods of minute white grubs and transforming beetles. Therefore such infested trees are a *menace to the living trees.*

(2) If the trees have reddish brown and partially fallen foliage, or if all of the foliage has fallen, it indicates that the broods of beetles have emerged *and that such trees are no longer a menace to the living ones.*

(3) If the trees die during the period between the 1st of March and the 1st of October they will be abandoned by the broods of beetles within a few weeks after the foliage has begun to fade.

(4) If the trees begin to die during the period between the 1st of October and the 1st of December the broods of beetles will remain in the bark until the following March or April.

HOW TO LOCATE THE INFESTED TREES.

The location of trees that are infested by the southern pine beetle is the first and one of the most important things to be done before definite plans are made for the active work of cutting the trees. Some of the essential things to be remembered are as follows:

(1) The southern pine beetle attacks the upper and middle portions of the trunks of healthy trees.

(2) A freshly attacked tree may show pitch tubes on the trunk or reddish boring dust around the base, or there may be no external evidence of attack until the leaves have begun to fade.

(3) By the time the tops are faded and the bark on the middle and upper trunk is dead the broods of the beetle are in an advanced stage of development, yet at the same time the bark on the lower third of the trunk may be living and show no evidence of attack or may be attacked by other kinds of insects which are not responsible for the death of trees.

(4) As soon as the bark begins to die on any part of the trunk it is attacked by numerous other insects, including the adults of the "sawyer" borers which do not attack healthy trees. (See fig. 3.)

(5) By the time the tops have changed from pale green to greenish brown the broods of the southern pine beetle have nearly all developed to the stage when they enter the outer bark to transform to the adults.

(6) By the time the tops have changed to a reddish hue the broods have developed and are either emerging or have emerged.

(7) During the warm months the broods will develop and emerge from a tree within about 30 to 40 days after it is attacked.

(8) Trees attacked in November will usually carry the broods over winter. The foliage of some trees will fade and reach the reddish stage before spring; other trees attacked in December or later may not fade until the warm days of February, March, or April.

Therefore, in estimating the character and extent of an infestation within any given area, or in locating infested trees and marking them for utilization or treatment, one has only to consider those with fading or greenish brown foliage or the first stage of the yellowish red tops.

ESSENTIAL DETAILS IN METHODS OF CONTROL.

There are certain essential details in the recommended methods of combating the southern pine beetle which must be observed in order to avoid not only serious mistakes but possibly ultimate failure:

(*a*) The principal clumps or patches of *dying* trees which are actually infested by the broods of the destructive beetle, as indicated by the *fading and dying* foliage, or otherwise, should be located and marked during the months of November, December, January, and February. In order to do this work, proper experience or special instruction is required. Therefore, some one who has had instructions should have charge of the work in each important area in which control work is to be undertaken.

(*b*) *The broods of the beetle* in the bark of the *main trunks* of 50 to 75 per cent of the medium to larger sized dying infested trees within an area of 8 or 10 square miles or more must be destroyed in order to stop their depredations.

(*c*) The broods may be destroyed by *one* or *more* of the following methods, the work to be done between the 1st of November and the 1st of March.

(1) Removing and burning the infested bark from the trunks of the standing trees; or

(2) Removing and burning the infested bark from the trunks of the trees after they have been cut down; or

(3) Scorching the infested bark, or burning the wood with the bark after the trees are cut down; or

(4) Placing the infested portions of the trunks in water; or

(5) *Converting the trunks of the infested trees into cordwood and using the wood for fuel before the beetles leave the bark the following spring;* or

(6) *Converting the infested trees into lumber or other products and burning the slabs or bark.*

(*d*) It is not necessary to burn the tops or branches of treated trees or to cut and burn small infested saplings *if the larger infested trees are disposed of.*

(*e*) It is not necessary to remove or destroy the bark on the lower portion of the trunks or on the stumps if it is not infested with the destructive beetle, and it is not necessary to cut or treat dead trees from which the beetles have emerged.

(*f*) It is necessary and essential that the broods of the destructive beetle in the bark of any portion of the main trunks of the medium to larger sized dying infested trees of any given locality should be destroyed.

(*g*) If the wood of the infested trees can be utilized for fuel, lumber, or other purposes, its value should cover the cost of the work. If the work of felling and barking the trees is done at direct expense, the cost will average 20 to 30 cents per tree.

(*h*) The cost of protecting the living timber of any locality with average infestation should not exceed an average of from 1 to 5 cents per acre for the total area of pine-covered land, and if estimated on a basis of volume it should not cost over 2 cents per cord of the living timber protected.

(*i*) The best time to conduct control operations against the southern pine beetle is during the period between November 1 and March 1.

(*j*) If a pine tree standing among or near a grove of woods of living pine is either struck by lightning or felled and barked or split into cordwood *during the summer* and early fall, it will, as a rule, attract the beetles within a radius of three or four miles and result in the starting of a new center of infestation and in the death of a large number of trees. It is dangerous to cut pine trees in the summer months when the southern pine beetle is killing trees in the neighborhood.

(*k*) The principal owners of pine in each community should cooperate in the disposal of the required infestation, but should not undertake the work until *some one or more of the owners is sufficiently familiar with the essential details of the proper methods.*

REQUIREMENTS FOR SUCCESS.

To succeed in any effort to protect the living pine from the destructive attacks of the southern pine beetle the broods of the beetle in the bark of the main trunk of the dying infested trees must be destroyed before they leave the bark. This may be done by utilizing the infested trunk, adopting one or more of the methods given, or by treatment at direct expense in cases where the wood can not be utilized.

The attainment of the best success from the practical application of any of these methods will depend on their adaptation to local con-

ditions and requirements for disposing of the infested timber, and strict adherence to certain details which are absolutely necessary to the destruction of the broods.

From the 1st of November to the 1st of the following March is the period in which to locate and mark the trees that are actually infested and in which the marked trees should be utilized or treated to kill the broods. In northern localities the period may be extended to the 1st of May.

The method of destroying the broods which in each case is the most economical and effectual can be determined by the owners in each community if they are sufficiently informed on the essential facts.

Detailed advice, recommendations, or conclusions as to the most economical and effective method of procedure for any given area should be deferred until certain reliable information is at hand regarding the local condition as to (*a*) the character and extent of the infestation, (*b*) the interest manifested by the people of the community in the value to them of the pine and the importance of protecting it as the source of future revenue, (*c*) the assurance of the majority of the owners that concerted action will be taken according to a definite plan and purpose, and finally, if a demonstration is desired, that local facilities will be offered for its successful prosecution.

If the owners of pine will consider the protection of their timber from the standpoint of a common interest and will realize the necessity for concerted action in the control work, success will be assured.

PUBLICATIONS RELATING TO INSECTS INJURIOUS TO FORESTS AND FOREST PRODUCTS.

AVAILABLE FOR FREE DISTRIBUTION.

Powder-post Damage by Lyctus Beetles to Seasoned Hardwood. (Farmers' Bulletin 778.)
Carbon Disulphid as an Insecticide. (Farmers' Bulletin 799.)
Gipsy Moth and Brown-tail Moth and their Control. (Farmers' Bulletin 845.)
Common White Grubs. (Farmers' Bulletin 940.)
White Ants as Pests in the United States and Methods of Preventing their Damage. (Farmers' Bulletin 1037.)
California Oak Worm. (Farmers' Bulletin 1076.)
Aspen Borer and How to Control It. (Farmers' Bulletin 1154.)
Insect Damage to the Cones and Seeds of Pacific Coast Conifers. (Department Bulletin 95.)
Sequoia Pitch Moth, a Menace to Pine in Western Montana. (Department Bulletin 111.)
European pine-shoot Moth; a Serious Menace to the Pine Timber in America. (Department Bulletin 170.)
Huisache Girdler. (Department Bulletin 184.)
Zimmerman Pine Moth. (Department Bulletin 295.)
Cypress Bark Scale. (Department Bulletin 838.)

FOR SALE BY THE SUPERINTENDENT OF DOCUMENTS, GOVERNMENT PRINTING OFFICE, WASHINGTON, D. C.

Report on Gipsy Moth Work in New England. 1915. (Department Bulletin 204.) Price 30 cents.
Cone Beetles: Injury to Sugar Pine and Western Yellow Pine. 1915. (Department Bulletin 243.) Price 10 cents.
Food plants of the Gipsy Moth in America. 1915. (Department Bulletin 250.) Price 10 cents.
Douglas Fir Pitch Moth. 1915. (Department Bulletin 255.) Price 5 cents.
Dispersion of Gipsy Moth Larvae by the Wind. 1915. (Department Bulletin 273.) Price 15 cents.
Solid Stream Spraying against the Gipsy Moth and the Brown-tail Moth in New England. 1917. (Department Bulletin 480.) Price 15 cents.
Termites, or "White Ants" in the United States: their Damage and Methods of Prevention. 1916. (Department Bulletin 333.) Price 15 cents.
Flat-headed Borers Affecting Forest Trees in the United States. 1917. (Department Bulletin 437.) Price 10 cents.
Control of the Gipsy Moth by Forest Management. 1917. (Department Bulletin 484.) Price 20 cents.
Protection from the Locust Borer. (Department Bulletin 787.) 1919. Price 5 cents.
Danger of General Spread of the Gipsy and Brown-tail Moths through Imported Nursery Stock. 1911. (Farmers' Bulletin 453.) Price 5 cents.
Two-lined Chestnut Borer. 1897. (Entomology Circular 24.) Price 5 cents.
White Ants. (Entomology Circular 50.) 1902. Price 5 cents.
White-Pine Weevil. 1907. (Entomology Circular 90.) Price 5 cents.
Insect Injuries to Wood of Dying and Dead Trees. 1910. (Entomology Circular 127.) Price 5 cents.
Insects in their Relation to Reduction of Future Supplies of Timber and General Principles of Control. 1910. (Entomology Circular 129.) Price 5 cents.
Oak Pruner. 1910. (Entomology Circular 130.) Price 5 cents.
Insect Damage to Standing Timber in National Parks. 1912. (Entomology Circular 143.) Price 5 cents.
Dying Hickory Trees, Cause and Remedy. 1912. (Entomology Circular 144.) Price 5 cents.

Insect Damage to Mine Props and Methods of Preventing Injury. 1912. (Entomology Circular 156.) Price 5 cents.

Gipsy Moth as Forest Insect, with Suggestions as to its Control. 1913. (Entomology Circular 164.) Price 5 cents.

Insect Enemies of Spruce in Northeast, with Recommendations for Preventing Losses. 1901. (Entomology Bulletin 28, n. s.) Price 10 cents.

Catalogue of Exhibit of Economic Entomology at Lewis and Clark Centennial Exposition, Portland, Oreg., 1905. 1905. (Entomology Bulletin 53.) Price 10 cents.

Black Hills Beetle, with Further Notes on Its Distribution, Life History, and Methods of Control. 1905. (Entomology Bulletin 56.) Price 5 cents.

Some Insects Injurious to Forests. 1906–1910. (Entomology Bulletin 58, 5 pts.) Price 20 cents.

Locust Borer. 1906. (Entomology Bulletin 58, pt. I.) Price 5 cents.

Western Pine-Destroying Bark Beetle. 1906. (Entomology Bulletin 58, pt. II.) Price 10 cents.

Additional Data on Locust Borer. 1917. (Entomology Bulletin 58, pt. III.) Price 5 cents.

Southern Pine Sawyer. 1909. (Entomology Bulletin 58, pt. IV.) Price 5 cents.

Insect Depredations in North American Forests and Practical Methods of Prevention and Control. 1909. (Entomology Bulletin 58, pt. V.) Price 10 cents.

Practical Information of Scolytid Beetles of North American Forests: 1, Bark Beetles of Genus Dendroctonus. 1909. (Entomology Bulletin 83, pt. I.) Price 25 cents.

Report on Field Work against Gipsy Moth and Brown-tail Moth. 1910. (Entomology Bulletin 87.) Price 35 cents.

Biology of the Termites of the Eastern United States, with preventive and Remedial Measures. 1915. (Entomology Bulletin 94, pt. II.) Price 20 cents.

Dispersion of Gipsy Moth. 1913. (Entomology Bulletin 119.) Price 20 cents.

○